Floristic Composition Of The Remaining Forests In Upland Cavite, Luzon Island, Philippines

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ABSTRACT

Cavite Province lies in the western monsoon forest zone of the Philippines and is considered as a tropical lowland rainforest making it a haven for diverse flora and fauna. The existing total land forest area is 8,624.956 hectares, but the only proclaimed national park is Mts. Palay-palay/Mataas na Gulod Protected Landscape. Unfortunately, the remaining forests are not spared from biodiversity loss because of its accessibility to Metro Manila, which eventually leads to unsustainable use of natural resources. This study was conducted to characterize the floristic composition, analyze the vegetation structure, and provide an inventory of plants in the provinces' remaining forests. Data collection was done from June 2014 to March 2016. Forty- six plots (20m x 20m) were used for tree species composition. The plot size for shrub and non-woody plants was 5m x 5m quadrats while for herbaceous plants it was 1m x 1m quadrat. Plant diversity and environmental parameters in each plot were measured and recorded. Canonical Correspondence Analysis (CCA) was employed to analyze the relationships between vegetation and environmental variables. The study documented 501 species belonging to 336 genera and 113 families. Three vegetation types, secondary forest, agricultural ecosystem, and semi-secondary (mixed forest) were documented in the remaining forests in Upland Cavite and the Protected Area (PA) part is characterized as lowland evergreen dipterocarp rainforest dominated by *Shorea guiso*, *Ficus chrysolepis, Diospyros pyrrhocarpa*, *Buchanania arborescens* and *Strombosia philippinensis*. The forest floor is dominated by *Anaxagorea luzonensis, Aglaonema commutatum* and *Bolbitis rhizophylla.*

KEY WORDS :

Plant diversity
Vegetation
Lowland dipterocarp forest
Mts. Palay-palay/Mataas Na Gulod Protected Landscape
Conservation

INTRODUCTION

The Philippine archipelago is considered as one of the megadiverse countries in the world (Conservation International, 2012) and recognized as one of the eight "hottest hotspots" in terms of biodiversity (Myers *et al*., 2000). With more than 7,100 islands and a unique geography, the country is a home to thousands of known as well as undocumented species of plants and animals. It is also a powerhouse because it supports a high rate of endemism and ranks second to Madagascar in terms of endemics, endemic species/area ratios and habitat loss having 64.7 species of endemic plants/area ratios per 100 km (Myers *et al*., 2000). The country is inhabited by 15,000 species of plants of which more than 8000 species are angiosperms (Madulid, 2005). However, the state of biodiversity is under severe pressure because of human activities such as unstoppable deforestation, pollution, mining and conversion of land leading to excessive loss of plants and animals. Destruction of tropical forests occurred at a rate of 1.4% or 89,000 hectares annually in 1990 (FAO, 2003) but in 2000-2005 the rate of forest cover change decreased by 20.2% to 1.98% per annum (Hansen *et al*., 2013).

Cavite is one of the provinces in the Philippines and lies in the western monsoon forest zone where most of its vegetation is considered as a tropical lowland rainforest (Cavite Profile, 2009) making it a haven for diverse plants and animals. The province experiences monsoon rains yearly, making some parts of the province a friendly habitat to thousands of classified and unclassified biodiversity

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Date Submitted: 29 June 2017
Date Accepted: 28 March 2018

species. Based on the profile of the province in 2009, there are two categories of land resources, namely forest and alienable and disposable lands. The existing total forest area in Cavite is 8,624.956 hectares. However, the only proclaimed national park is Mts. Palay-palay and Mataas na Gulod Protected Landscape with an area of 4,000 hectares while five unclassified forests are found in Upland Cavite (Cavite Province Report, 2009). These forests are rich in different products such as timber (Luyon and Medecilo, 2006; Cervillon, 2007) and rattans (Silveo, 2008) as well as in sources of water. However, the remaining forests are not spared from threats of biodiversity loss. It is therefore necessary to document these plant species before they vanish. Cataloguing plant species in database would not only contribute to the increasing knowledge to the field of taxonomy but would also add awareness regarding the conservation status of plant species studied.

Several studies have already been conducted in the protected area. Vegetation analysis was conducted in Mts. Palay-palay/ Mataas na Gulod Protected Landscape by Luyon and Medecilo (2006). This study focused only in the protected area with emphasis on tree species with Diameter at Breast Height (DBH) ≥ 10 cm using Point-Center Quarter Method (PCQM) with no data on shrub and herb species. Based on their study, the vegetation is classified as lowland evergreen dipterocarp forest dominated by *Shorea guiso* and other dipterocarp species. Causaren (2016) and Lagat (2012) studied the vegetation of forest fragments in Cavite in relation to the abundance and distribution of herpetofauna. No study has been conducted in other forests in Cavite.

Because of Cavite's proximity to Manila and the establishment of industrial zones in the province, in-migration occurs leading to rapid increase in population. The province has the highest population next to NCR, and it is estimated that in 2017 the population will rise to six million (Barrera pers. comm.). Given this scenario, rapid urbanization, land conversion and non-sustainable use of natural resources will eventually affect the remaining forests of the province. The diversity and floral composition are important elements to determine the human activities as well as environmental factors affecting the vegetation of an area.

Lack of protection and unsustainable use of natural resources threaten the area's biodiversity. It is therefore even more urgent to conduct vegetation studies in the pristine forests of Upland Cavite to determine what species are in need of protection and conservation. The output will also provide baseline information for policy makers of the province to highlight the impact of climate change if conservation measures would not be integrated in the future development plans. It is intended that the present study should form the basis for any future management plans for the province and add to the present knowledge on the effective management of its plant ecosystem.

The sites are the remaining forests in Upland Cavite i.e. Tagaytay City, Silang, Magallanes, Amadeo, Indang, General Aguinaldo (Bailen), Ternate and Maragondon. The present study is the first systematic survey of the vegetation in the province. Previous studies concentrated on tree species in selected habitat particularly Mts. Palay-palay Protected Landscape using the PCQM method. The present study aims to assess the species composition, describe the vegetation types and determine the conservation and taxonomic status of species of plants. The study also compared the vegetation in each site, documented all the species encountered and determined the threats and conservation status of each species.

MATERIALS AND METHODS

Description of the Study Area. The study was conducted in the remaining forests of Upland Cavite, more or less 65km away from Metro Manila. Upland Cavite covers the municipalities of Amadeo, Bailen, Indang, Magallanes, Maragondon, Silang, Ternate and Tagaytay City (Figure 1). It is located within the upland characterized as low agro-ecological zone and the forest structure can be classified as agricultural, secondary and lowland evergreen dipterocarp forest. Some of the forests are patches with an estimated size of 0.25 hectares to 0.75 hectares. The protected area with a size of more or less 4,000 hectares is found in the municipalities of Ternate and Maragondon- (Cavite) and Nasugbu, Batangas.

Data Collection. The collection of data was gathered from August 2014 to March 2016. A total of 46 quadrats (20 m ×

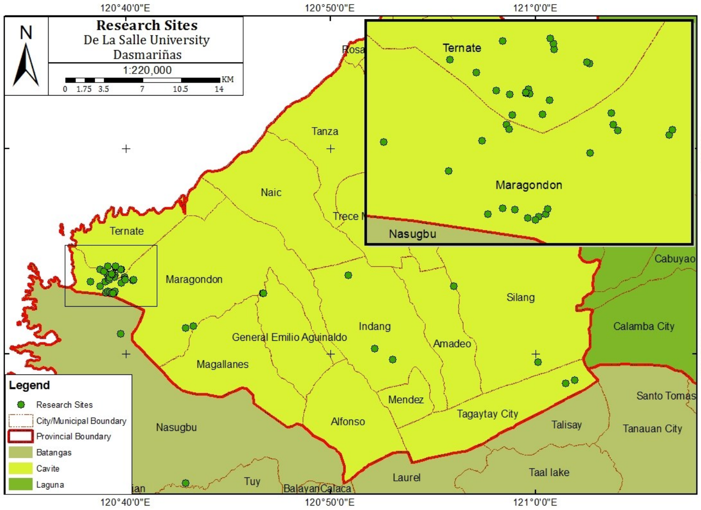

Figure 1. Map of Cavite showing the research sites in Upland Cavite.

20 m) (Table 1) were delineated for shrub and tree data based on the type of the vegetation following the procedure of Roberts –Pickette and Gillespie (1999). In each of the major plots, two subplots (5 m x 5 m) were established at the center and corner for shrubs while four subplots (1 m x 1 m) for herbs. All woody species with DBH ≥ 10 cm were recorded including the height and distance from the center. DBH was measured at 1.3 m high from the ground. Altitude and exact location were measured using GPS. Likewise, environmental parameters such as relative humidity, and air and soil temperature, were also recorded for each plot. Relative humidity (RH) was measured using a BACHARACH sling psychrometer. In the shady part of each major plot (20 m x 20 m), RH was taken by whirling the device for 11/2 minutes to stabilize temperatures. The wet bulb and dry bulb temperature readings were noted and set opposite each other on the side rule type calculator scales to obtain % RH indicated by the arrowhead on the lower scale. Air temperature was taken by hanging an ordinary laboratory thermometer 1 m high from the ground for 3 minutes, then the temperature reading was noted. To measure the soil temperature, a soil thermometer (Taylor 5969N) was inserted 10 cm in the ground, and the readings were noted every after 3 minutes. The reported value for each parameter is an average of three readings per site.

All plants were collected and placed in plastic bags for classification and identification. In each plant collected, the following data were recorded: (a) date and place of collection, (b) collection number, (c) habitat, (d) altitude, (e) coordinates, (f) collectors, and (g) notes on flower color and other reproductive organs. Specimens were deposited in the DLSU-D Herbarium. A checklist of all plants was prepared.

The collected plants were identified using the taxonomic keys from floras and monographs of Co *et al*. (2006), Merrill (1923–1926), Zamora and Co (1986), Madulid (1995), Flora Malesiana Series (1995–2012), Rojo (1999), Fernando *et al*. (2004), Pelser *et al.* (2011 onwards) and LaFrankie (2010). The preliminary identified specimen were brought to the Philippine National Herbarium (PNH) for further verification.

The taxonomic/conservation status for each species collected from the field was determined whether threatened, endemic, rare, vulnerable and critically endangered was assessed based on the national list of threatened Philippine plants (Fernando et al., 2008, 2017) and IUCN (2016).

Data Analysis. Density, Diameter at Breast Height (DBH), frequency, dominance, basal area, and Importance Value Index (IVI) were used for description of vegetation structure. The structural parameters were analyzed using the following formula:

(1) Basal area of a tree = circumference (C) 2/4 or (2/39.5).
(2) Diameter at Breast Height (DBH) = (/).
(3) Dominance = total cover or basal area of species A/ area sampled for each plot (20 m x 20 m).
(4) Relative dominance = dominance for species A/ total dominance of all species × 100.
(5) Density = (number of individuals of species A/ area sampled which is 20 m x 20 m).
(6) Relative density = (number of individuals of species A/ total number of individuals in area (20 m x 20 m)) × 100.
(7) Frequency = (number of plots in which species A occurs/ total number of plots sampled).
(8) Relative frequency = (frequency value for species A/ total of all frequency values for all species) × 100.
(9) Importance value = relative density + relative frequency + relative dominance.

Cluster Analysis. The environmental parameters such as soil and air temperature, elevation, and relative humidity for each plot along with the number of species and individuals were tabulated in a matrix using Microsoft Excel. The different characters were then coded in a multi-state order. Each coded character state was recorded in binary order for the numerical analysis.

Cluster analysis was performed using the Paleontological Statistics Software Package for Education and Data Analysis (PAST). Similarity coefficients were calculated and dendograms were constructed using UPGMA. Ordination using correlation of Canonical Correspondence Analysis (CCA) was computed to highlight the similarities and differences among the plots.

RESULTS AND DISCUSSION

Research Sites and Environmental Parameters. Forty-six (46) plots were established in different municipalities in Upland Cavite. The elevation ranged from 64 to 608 m.a.s.l.. Air temperature varies in each site. The number of trees in the plots ranged from 9 to 44. The plots with the highest number of trees were found in Maragondon and Ternate since these sites are part of the Protected Area (PA). From the 46 plots, 11 were established outside PA and found in the municipalities of Amadeo, Bailen, Indang, Magallanes, Silang and Tagaytay City. Thirty-five (35) plots were delineated in Ternate and Maragondon that are part of PA. The number of plots from each municipality varied depending on the size of the remaining forests (Table 2).

The Canonical Correspondence Analysis (CCA) axis (Figure 2) shows that elevation and relative humidity are the most important variables in axis 1 and axis 2. Some of the

Table 1. List of research sites with corresponding environmental parameters, elevation, number of trees (≥ 10 DBH) and number of species.

Sites	Municipality	Site Classification	Elevation (masl)	Air Temp. (°C)	Relative Humidity	Soil temp. (°C)	# of tree individuals	# of species
1	Amadeo	Not PA	272	26	74	24	11	9
2	Bailen 1	Not PA	69	28	85	25	9	8
3	Bailen 2	Not PA	64	29	84	27	22	12
4	Indang 1	Not PA	168	29	70	26	12	7
5	Indang2	Not PA	356	27	84	24	15	8
6	Indang3	Not PA	168	27	74	24	17	11
7	Magallanes1	Not PA	78	26	83	25	15	12
8	Magallanes2	Not PA	284	25	86	24	20	17
9	Maragondon1	PA	324	28	84	25	28	16
10	Maragondon2	PA	324	28	84	25	28	15
11	Maragondon3	PA	340	26	80	23	14	5
12	Maragondon4	PA	406	24	74	20	24	15
13	Maragondon5	PA	418	24	80	20	28	17
14	Maragondon7	PA	406	23	74	20	23	15
15	Maragondon8	PA	608	20	79	15	14	11
16	Maragondon9	PA	347	25	80	20	23	9
17	Maragondon10	PA	368	24	86	20	25	10
18	Maragondon11	PA	365	25	86	20	30	17
19	Maragondon12	PA	265	29	86	27	30	17
20	Maragondon13A	PA	285	26	100	23	19	11
21	Maragondon13B	PA	406	20	79	15	29	22
22	Maragondon14	PA	342	26	100	23	20	15
23	Silang	Not PA	378	24	90	22	26	25
24	Tagaytay1	Not PA	534	27	59	25	14	7
25	Tagaytay2	Not PA	398	25	80	24	17	9
26	Ternate1	PA	361	27	86	22	34	23
27	Ternate2	PA	421	26	90	24	28	15
28	Ternate3	PA	345	26	88	23	26	19
29	Ternate4	PA	332	32	88	27	22	12
30	Ternate5	PA	338	25	81	22	16	12
31	Ternate6	PA	330	31	88	28	27	15
32	Ternate7	PA	339	33	84	29	23	14
33	Ternate8	PA	369	24	92	18	28	15
34	Ternate9	PA	422	20	84	18	36	24
35	Ternate10	PA	384	24	92	21	17	15
36	Ternate11	PA	432	18	84	13	35	14
37	Ternate12	PA	460	28	78	25	27	17
38	Ternate13	PA	436	30	92	26	22	14
39	Ternate14	PA	446	26	100	24	44	21
40	Ternate16	PA	308	25	70	22	23	17
41	Ternate17	PA	447	25	90	26	24	17
42	Ternate18	PA	433	28	86	27	30	21
43	Ternate19	PA	419	26	84	24	20	7
44	Ternate20	PA	358	27	84	25	24	15
45	Ternate21	PA	371	26	91	25	18	14
46	Ternate22	PA	371	27	85	25	26	21

Legend: PA – Protected Area, Not PA – Not Protected Area

Table 2. List of plant species recorded in Upland Cavite, Philippines according to The Angiosperm Phylogeny Group Classification IV (2016), The Pteridophyte Phylogeny Group (2016) and their taxonomic/conservation status (DAO 2017; IUCN Redlist, 2016).

FAMILY	SPECIES	TAXONOMIC/ CONSERVATION STATUS
A. Lycophytes and Ferns		
Aspleniaceae	*Asplenium polyodon* G. Forst.	
	Asplenium tenerum G. Forst.	
Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	
Blechnaceae	*Blechnum orientale* L.	
	Stenochlaena palustris (Burm. f.) Bedd	
Cyatheaceae	*Cyathea contaminans* Copel.	T
Davalliaceae	*Davallia hymenophylloides* (Blume) Kuhn	
	Davallia trichomanoides Blume	
Dryopteridaceae	*Bolbitis rhizophylla* (Kauf.) Hennipman	
	Bolbitis heteroclita (C.Presl) Ching	
	Polystichum horizontale C. Presl	
Lindsaeaceae	*Lindsaea fissa* Copel.	
	Lindsaea obtusa J.Sm. Ex. Hook	
	Sphenomeris chinensis (L.) Maxon	
Lycopodiaceae	*Huperzia squarrosa* (G. Forst.) Trevis.	EC
Lygodiaceae	*Lygodium auriculatum* A. Rich	
	Lygodium circinnatum (Burm. f.) Sw.	
	Lygodium japonicum (Thunb.) Sw.	
Marattiaceae	*Angiopteris evecta* Sw.	T
Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Schott	
	Nephrolepis cordifolia (L.) Presl.	
	Nephrolepis exaltata (L.) Schott	
	Nephrolepis falcata (Cav.) C. Chr.	
Ophioglossaceae	*Ophioglossum reticulatum* L.	
Polypodiaceae	*Drynaria quercifolia* (L.) J. Sm.	
	Microsorum longissimum Merr.	
	Microsorum scolopendria (Burm. f.) Copel	
	Lepisorus mucronatus (Fee) Li Wang	EC
Pteridaceae	*Adiantum caudatum* L.	
	Adiantum philippense L.	
	Pityrogramma calomelanos (L.) Link.	
	Pteris cretica L.	
	Pteris ensiformis Burm. F.	
	Pteris mutilata L.	
	Taenitis luzonica (Alderw.) Holttum	
	Trichiogramma alismifolia (C. Presl) Kuhn	
Tectariaceae	*Tectaria dissecta* (G. Forst.) Lellinger	
	Tectaria gandichaudii (Mett.) Mazon	
	Tectaria hilocarpa (Fee). M.G. Price	

Thelypteridaceae	*Amphineuron terminans* (J. Sm.) Holttum	
	Anthrophyum sessilifolium (Cav.) Spreng.	
	Christella parasitica (L.) Lev.	
	Christella dentata (Forsk.) Brownsey & Jermy	
	Macrothelypteris polypodioides (Hook.) Holttum	
	Pneumatopteris glabra (Copel.) Holttum	
	Pneumatopteris laevis (Mett.) Holttum	
	Pneumatopteris nitidula (C. Presl) Holttum	
	Pneumatopteris truncata (Poir.) Holttum	
	Pronephrium amphitrichum Holttum	
	Sphaerostephanos hirsutus (Kunze ex Mett.) Holttum	
Selaginellaceae	*Selaginella philippina* Spring	
	Selaginella tamariscina (Beuv.) Spiring	V
B. Gymnosperms		
Cycadaceae	*Cycas ruminiana* Porte ex Regel	
Gnetaceae	*Gnetum indicum* Merr.	
Pinaceae	Pinus kesiya Royle ex Gordon	
C. Flowering plants		
Acanthaceae	*Blechum pyramidatum* Urb.	
	Hemigraphis oblongifolia Merr.	
	Ptyssiglottis undulata (Merr.) B. Hansen	EC
Actinidiaceae	**Saurauia luzoniensis* Merr.	EC
Amaranthaceae	*Alternanthera sessilis* (L.) DC	
	Cyathula prostrata (L.) Blume	
	Cyathula prostrata var. *prostrata*	
	Deeringia amaranthoides (Lam.) Merr.	
	Deeringia polysperma (Roxb.) Moq.	
Anacardiaceae	*Buchanania arborescens* (Blume) Blume	
	Dracontomelon dao (Blanco) Merr. & Rolfe	V
	**Dracontomelon edule* Merr.	V
	Koordersiodendron pinnatum (Blco.) Merr.	V
	Mangifera indica L.	
	Semecarpus cuneiformis Blanco	
Annonaceae	*Anaxagorea luzonensis* Merr.	
	Artabotrys suaveolens Blume	
	Cananga odorata (Lam.) Hook. f *&* Thomson	
	Dasymaschalon clusiform (Merr.) Merr.	EC
	Goniothalamus amuyon Merr.	EC
	Miliusa vidalii J. Sinclair	EC
	**Mitrephora lanotan* Merr.	EC
	Platymitra arborea (Blanco) Kessler	EC
	Uvaria grandiflora Roxb.	
	Uvaria littoralis (Blume) Blume	

Apiaceae	*Centella asiatica* (L.) Urb.	
Apocynaceae	*Alstonia macrophylla* Wall.	EC
	Alstonia scholaris (L.) R. Br.	
	**Tabernaemontana pandacaqui* Poir.	
	**Voacanga globosa* Merr.	EC
	**Wrightia laniti* (Blanco) Merr.	EC
	**Wrightia pubescens* R. Br.	
Araceae	*Aglaonema commutatum* Schott	
	Alocasia macrorrhizos (L.) G. Don	
	Alocasia ramosii Hay	EC
	Amorphophallus paeonifolius (Dennst.) Nicolson	
	Amorphophalus sp. nov.	
	Colocasia esculenta L.	
	Epipremnum pinnatum (L.) Engl.	
	Homalomena philippinensis Engl.	EC
	Pothoidium lobbianum Schott	
	Photos hermaphroditus (Blanco) Merr.	
	Pothos scandens L.	
	Rhaphidophora perkinsae Engl.	EC
	Schismatoglottis calyptrata (Roxb.) Zoll. & Moritzi	
	Syngonium podophyllum Schott	
	Xanthosoma sagittifolium (L.) Schott	
	Xanthosoma violaceum Schott	
Araliaceae	*Polyscias nodosa* Seem.	
	Schefflera elliptica (Blume) Harns	EC
Arecaceae	*Arenga pinnata* Merr.	
	Calamus merrillii Becc.	EC
	Calamus multinervis Becc.	
	Calamus ornatus Blume *var. philippinensis* Becc.	NT
	**Cocos nucifera* L.	
Asteraceae	*Ageratum conyzoides* L.	
	Bidens pilosa L.	
	Blumea balsamifera DC.	
	Blumea manillensis DC	EC
	Chromolaena odorata (L.) R.M. King & H. Rob.	
	Crassocephalum crepidioides (Benth.) S. Moore	
	Eclipta prostrata (L.) L.	
	Elephantopus tomentosus L.	
	Eupatorium cannabinum L.	
	Gynura procumbens (Lour.) Merr.	
	Mikania cordata (Burm.f.) B.L Rob.	
	Pseudelepantophus spicatus (Juss.) Rohr	
	Synedrella nodiflora Gaertn.	
	Tridax procumbens L.	
	Wedelia chinensis Merr.	

Balsaminaceae	*Impatiens caviteana* Hook. f.	EC in Cavite
Begoniaceae	*Begonia hirtella* Link.	
	Begonia calcicola Merr.	EC
	Begonia lagunensis Elmer	EC
	Begonia nigritarum Steud.	
	Begonia sp. nov.	
	Begonia sp.	
Bignoniaceae	*Spathodea campanulata* P. Beauv.	
	Radermachera pinnata Seem.	EC
Boraginaceae	**Cordia dichotoma* G. Forst.	
	Heliotropium indicum L.	
Brassicaceae	*Rorippa nasturtium - aquaticum* (L.) Hayek	
	Rorippa indica (L.) Hiern.	
Burseraceae	*Canarium asperum* Benth.	EC
	**Canarium hirsutum* Willd.	
	Canarium luzonicum Miq.	EC
	Canarium ovatum Engl.	EC
	Canarium euryphyllum Kurz	
	**Garuga floribunda* Decne. var. *floribunda*	
Calophyllaceae	*Calophyllaum blancoi* Planch. & Triana	EC
	**Calophyllum inophyllum L.*	
Cannabaceae	*Celtis luzonica* Warb.	EC
	**Celtis philippinensis* Blanco	
Casuarinaceae	*Casuarina equisetifolia* L.	
Cecropiaceae	*Poikilospermum suaveolens* (Blume) Merr.	
Chrysobalanaceae	*Maranthes corymbosa* Blume	
Cleomaceae	*Cleome rutidosperma* DC	
	Cleome viscosa L.	
Clusiaceae	*Garcinia binucao* Choisy	EC
	**Garcinia dives* Pierre	EC
	**Garcinia rubra* Merr.	EC
Combretaceae	*Terminalia microcarpa* Decne.	
Commelinaceae	*Commelina diffusa* Burm. f.	
	Pollia secondiflora (Blume) Bakh. f.	
Convolvulaceae	*Erycibe malaccensis* C.B. Clarke	
	Ipomoea triloba L.	
	Merremia umbellata (L.) Hallier f.	
	Operculina turpethum (L.) Silva Manso	
Costaceae	*Cheilocostus speciosus* (J. Koenig) C.D. Specht.	
Crypteroniaceae	*Crypteronia cumingii* Endl.	
Cucurbitaceae	*Coccinea grandis* (L.) Voigt	
	Melothria pendula L.	
	Momordica charantia L.	
	Momordica sp.	
	Zehneria mucronata (Blume) Miq.	
Cyperaceae	*Fimbristylis* sp.	
	Scleria scrobiculata Zoll.	
Datiscaceae	*Octomeles sumatrana* Miq.	
Dilleniaceae	*Dillenia philippinensis* Rolfe	

Dioscoreaceae	*Dioscorea alata* L.	
	Dioscorea divaricata Blanco	EC
	Dioscorea hispida L.	
	Dioscorea luzoniensis Schauer	EC
Dipterocarpaceae	*Parashorea malaanonan* (Blco.) Merr.	
	Shorea guiso Blume	
	**Shorea negrosensis* Foxw.	EC
	Shorea polysperma Merr.	T/VU
Ebenaceae	*Diospyros philippinensis* A.DC.	EC
	Diospyros pilosanthera Blanco	EC
	Diospyros pyrrhocarpa Miq.	EC
Eleaocarpaceae	*Eleaocarpus monocera* Cav.	
Euphorbiaceae	*Acalypha amentacea* Roxb.	
	Alchornea rugosa (Lour.) Müll.Arg.	
	Aleurites molucanna (L.) Willd.	
	** Aporosa symplocosifolia* Merr.	EC
	Bischofia javanica Blume	
	Breynia vitis-idaea (Burm.f.) C.E.C.Fisch.	
	Claoxylon albicans (Blanco) Merr.	
	Codiaeum luzonicum Merr.	EC
	Croton angustifolius Ham.	
	Croton argyratus Blume	
	Croton leiophyllus Müll.Arg.	EC
	Croton pampangensis Croizat	EC
	**Croton* sp.	
	**Endospermum peltatum* Merr.	EC
	Euphorbia hirta L.	
	Glochidion album (Blanco) Merr.	
	**Grewia multiflora* Blanco	
	Homalanthus populneus (Geiseler) Pax	
	Macaranga grandifolia Merr.	V
	Macaranga hispida Müll. Arg.	
	Macaranga tanarius (L.) Müll. Arg.	
	Macaranga tanarius (L.) Müll.Arg. var. *tomentosa*	
	Mallotus philippinensis (Lam.) Müll. Arg.	EC
	**Melanolepis multiglandulosa* Rchd. & Zoll.	
	Neotrewia cumingii Pax & K. Hoffm.	
Fabaceae	*Abroma augustum* (L.) Murray	
	Acacia farnesiana (L.) Willd.	
	Albizia acle Merr.	
	Albizia procera Benth.	
	Arachis pintoi Krapov. & W.C. Greg.	
	Archidendron clypearia (Jack.) I.C. Nielsen	
	Archidendron clypearia var. *casai* (Blco.) I.C. Nielsen	
	Bauhinia purpurea L.	
	Calopogonium mucunoides Desv.	
	Centrosema pubescens Benth.	
	Clitoria ternatea L.	
	Crotalaria incana L.	
	Cynometra ramiflora Miq.	
	Dalbergia mimosella (Blanco) Prain	
	Derris elliptica var. *glaucophylla* (Miq.) Kaneh. & Hatus.	
	Leucaena leucocephala (Lam.) de Wit.	

	Mimosa diplotricha C. Wight ex Sauvalle	
	Mimosa pudica L.	
	Parkia timoriana (DC) Merr.	
	Phanera integrifolia Benth.	
	Phyllodium pulchellum (L.) Desv.	
	Pterocarpus indicus Willd.	
	Pterocarpus indicus Willd. f. echinatus (Pers.) Rojo	CR
	**Samanea samman* (Jacq.) Merr.	
	Senna alata (L.) Roxb.	
	Senna obtusifolia (L.) Irwin & Barneby	
	Strongylodon macrobotrys A. Gray	EC
	Tamarindus indicus L.	EC
Fagaceae	*Lithocarpus solerianus* Rehder	EC
	**Lithocarpus sultii* Soepadmo	EC
Flagelariaceae	*Flagellaria indica* L.	
Gesneriaceae	*Gesneria* sp.	
Hernandiaceae	*Illigera luzonensis* Merr.	
Hypericaceae	**Cratoxylum solerianum*	
	Cratoxylum sumatranum (Jack.) Bl.	
Hypoxidaceae	*Curculigo capitulata* (Lour.) Kuntze	
Icacinaceae	*Gomphandra luzoniensis* Merr.	EC
	Gonocaryum calleryanum (Baill.) Becc.	EC
	Phytocrene macrophylla (Blume) Blume	EC
Lamiaceae	*Clerodendrum intermedium* Cham.	
	Clerodendrum minahassae Teijsm. & Binn.	
	Gmelina arborea Roxb.	
	Hyptis capittata Jacq.	
	Ocimum tenuiflorum L.	
	Plectranthus sp.	
	**Premna odorata* Blanco	
	**Vitex parviflora* Juss.	EC
Lauraceae	*Cinnamomum longifolium* Lukman	V
	Cinnamomum mercadoi S. Vidal	V
	**Cryptocarya infectoria* Miq.	
	Cryptocarya oligocarpa Merr.	EC
	Cryptocarya teysmanniana Miq.	
	Litsea albayana S. Vidal	EC
	**Litsea fulva* (Blume) Fern.-Vill.	
	Litsea glutinosa (Lour.) C.B. Rob.	
	Litsea luzonica Fern.-Vill.	EC
	Litsea perottetii Fern. Vill.	
	Neolitsea villosa Merr.	
Lecythidaceae	*Barringtonia racemosa* (L.) Spreng.	
	Planchonella nitida Dubard	
	Planchonia spectabilis Merr.	
Leeaceae	**Leea aculeata* Blume	
	Leea congesta Elmer	
	Leea guineensis G. Don.	

Lythraceae	**Lagerstroemia paniculata* (Turcz.) Vidal	EC
	**Lagerstroemia speciosa* (L.) Pers.	
Magnoliaceae	**Magnolia candollei* Link.	EC
	**Talauma villariana* Rolfe	EC
Malvaceae	*Bombax malabaricum* DC.	
	Hibiscus tiliaceus L.	
	Malachra capitta (L.) L.	
	Malvaviscus sp.	
	Microcos stylocarpa Burret	
	Sida rhombifolia L. ssp. *rhombifolia*	
	Triumfetta bartamia L.	
	Urena lobata L.	
Marantaceae	*Donax canniformis* K. Schum.	
Melastomataceae	*Melastoma malabathricum* L.	
	**Memecylon densiflorum* Merr.	
	Memecylon ovatum Sm.	
Meliaceae	**Aglaia elliptica* Blume	
	**Aglaia korthalsii* Pellegr.	
	**Aglaia leptantha* Miq.	
	**Aglaia luzoniensis* Merr. & Rolfe	
	Aglaia rimosa Merr.	EC
	**Aglaia tomentosa* Teijsm. & Binn.	
	* *Aphanamixis polystachya* (Wall.) R. Parker	V
	Chisocheton cumingianus Harms	EC
	Chisocheton pentandrus (Blanco) Merr.	EC
	**Dysoxylum arborescens* (Blume) Miq.	EC
	Dysoxylum cumingianum C. DC.	
	Dysoxylum gaudichianum (A. Juss.) Miq.	
	Dysoxylum pauciflorum Merr.	EC
	Guioa koelreuteria (Blanco) Merr.	
	Sandoricum koetjape Merr.	
	Toona calantas Merr. & Rolfe	CR
Menispermaceae	*Arcangelisia flava* Merr.	
	Tinospora glabra (Burm. f.) Merr.	
Moracae	*Artocarpus blancoi* Merr.	EC
	Artocarpus heterophyllus Lam.	
	Artocarpus ovatus Blanco	
	Artocarpus rubrovenia Warb.	
	**Broussonetia luzonica* Bureau	EC
	**Ficus ampelos* Burm. f.	
	**Ficus appendiculata* Merr.	EC
	Ficus balete Merr.	EC
	Ficus benjamina Wall.	
	Ficus callophylla Blume	EC
	Ficus chrysolepis Miq.	EC
	Ficus fistulosa Reinw. ex Blume	
	Ficus fiskei Elmer	EC

	**Ficus gul* K. Schum. & Lauterb.	
	Ficus heteropleura Blume	
	Ficus magnoliifolia Blume	
	Ficus minahassae (Teijsm. & de Vriese.) Miq.	
	Ficus nota Merr.	EC
	Ficus odorata Merr.	EC
	**Ficus pubinervis* Blume	
	Ficus pseudopalma Blanco	EC
	Ficus septica Burm. f.	EC
	Ficus ulmifolia Lam.	EC
	Ficus variegata Blume	
	Maclura cochinchinensis (Lour.) Corner	
	**Streblus asper* Lour.	
Musaceae	*Musa cerans* (Blanco) Teodoro	EC
Myristicaceae	*Knema glomerata* Merr.	
	Myristica philippinensis Lam.	EC/T
Myrtaceae	*Decaspermum fruticosum* J.R. Forst.	
	Syzygium calubcob (C.B. Rob.) Merr.	
	**Syzygium densinervium* (Merr.) Merr.	T
	**Syzygium merrillii* (C.B. Rob.) Merr.	EC
Nyctaginaceae	*Pisonia umbellifera* Seem.	
Ochnaceae	**Brackenridgea fascicularis* (Blanco) Fern.-Vill. subsp. *fascicularis*	EC
Olacaceae	**Anacolosa frutescens* Blume	EC
	Strombosia philippinensis S. Vidal	EC
Oleaceae	**Chionanthus coriaceus* (S. Vidal) Yuen P. Yang & S.Y. Lu	EC
	**Chionanthus ramiflorus* Roxb.	
	Jasminum sp.	
Opiliaceae	*Champereia manillana* Merr.	
Orchidaceae	*Calanthe* sp.	
	Goodyera rubicunda (Blume) Lindl.	
	Grammotophyllum multiflorus Lindley *var. tigrinum*	
	Nervilia sp.	
	Vanilla sp.	
Pandanaceae	*Freycinetia* sp.	
	**Pandanus luzonensis* Merr.	EC
Phyllanthaceae	*Antidesma bunius* (L.) Spreng	
	Antidesma ghaesembilla Gaertn.	
	Antidesma montanum Blume	
	**Antidesma pentandrum* Merr.	
	**Bridelia penangiana* Hook. f.	
	Bridelia stipularis (L.) Blume	
Piperaceae	*Pepperomia umbeliflora* Yunck.	
	Peperomia pellucida (L.) Kunth	
	Piper sp.	

Poaceae	*Chrysopogon aciculatus* Trin.	
	Cynodon dactylon (L.) Pers.	
	Cyrtococcum patens A. Camus	
	Dinochloa luconiae (Munro) Merr.	
	Eleusine indica L.	
	Isachne globosa (Thunb.) Kuntze	
	Miscanthus floridulus Warb. Ex K. Schum. & Lauterb.	
	Panicum maximum Jacq.	
	Panicum sarmentosum Roxb.	
	Paspalum conjugatum P.J. Bergius	
	Paspalum scrobiculatum L.	
	Pennisetum sp.	
	Pennisetum macrostachys (Brongn.) Trin.	
	Pogonatherum crinitum (Thunb.) Kunth	
	Rottboellia paradoxa de Koning & Sosef	
	Setaria geniculata (Lam.) P. Beauv.	
	Setaria palmifolia Stapf.	
	Sorghum propinquum (Kunth) Hitchc.	
	Thysonoleana latifolia (Roxb. ex Hornem.) Honda	
Polygonaceae	*Polygonum barbatum* L.	
	Triplaris cumingiana Fisch. & C.A. Mey. ex. C.A. Mey	
Primulaceae	*Ardisia pyramidalis* Pers.	
	**Ardisia squamulosa* C. Presl.	EC
	Maesa laxa Mez.	EC
Putranjivaceae	*Drypetes monosperma* Pax & K. Hoffm.	
Rhamnaceae	**Ziziphus talanai* Merr.	T
	Ziziphus trinervia Roxb.	EC
Rhizophoraceae	*Carallia brachiata* (Lour.) Merr.	
Rosaceae	*Rubus moluccanus* L.	
	Rubus rosifolius Sm.	
	Prunus grisea Blume ex Mull. (Berol.) Kalkman	
Rubiaceae	*Canthium monstrosum* A. Rich.	EC
	**Canthium* sp.	
	**Coffea arabica* L.	
	**Coffea robusta* L. Linden	
	Hypobathrum glomeratum (Bartl.) L. Schum.	EC
	Hypobathrum longiflorum (DC) KM Wong	EC
	Ixora bartlingii Elmer	EC
	Lasianthus sp.	
	Morinda citrifolia L. var. bracteata F.M.Bailey	
	Mussaenda philippinensis Merr.	
	**Nauclea elmerii* Merr.	
	**Nauclea orientalis* L. & Merr.	
	Neonauclea bartlingii Merr.	
	Ophiorrhiza stenophylla Merr.	EC in Cavite only

	Paederia macrocarpa Wall.	
	Pavetta barnesii Elmer	
	Pavetta luzoniensis (Vidal) Merr.	EC
	Psychotria chasalioides Merr.	EC
	Psychotria diffusa Merr.	EC
	Psychotria manillensis Bartl. ex D.C.	EC
	Psychotria sp.	
	Spermococe hispida L.	
	Tarennoidea wallichii (Hook. f.) Tirverg. & Sastre	
	Wenlandia luzonensis DC	
Rutaceae	*_Citrus hystrix_ DC.	
	*_Evodia confusa_ Merr.	
	Lunasia amara Blnco	EC
	Melicope curranii Merr.	
	Melicope triphylla Merr.	EC
	Micromelum compressum Merr.	
	Severinia retusa (Merr.) Swingle	
Salicaceae	*_Casearia fuliginosa_ Blanco	
	Flacourtia rukam Zull. & Moritzi	
	*_Homalium bracteatum_ Benth.	EC
Sapindaceae	_Allophylus cobbe_ (L.) Blume	
	Cardiospermum halicacabum L.	
	Dimocarpus longan Lour. subsp. _malesianus Leenh. var. malesianus_	
	Lepisanthes fruticosa (Roxb.) Leenh.	EC
	Mischocarpus pentapetalus Radlk.	
	*_Harpullia arborea_ (Blanco) Radlk.	
	Litchi chinensis Sonn. subsp. philippinensis (Radlk.) Leenh	EC
	Nephelium ramboutan-ake (Labill.) Leenh.	
Sapotaceae	_Chrysophyllum cainito_ L.	
	*_Palaquium foxworthyii_ Merr.	EC
	*_Palaquium loheri_ Merr.	
	*_Planchonella nitida_ Dubard	
	Pometia pinnata J.R. Forst. & G. Forst.	
Solanaceae	_Solanum biflorum_ R. Br.	
	Solanum nigrum L.	
Staphyleaceae	*_Turpinia ovalifolia_ Elmer	
	Turpinia sphaerocarpa Hassk.	EC
Sterculiaceae	*_Heritiera littoralis_ Aiton	EC
	*_Heritiera sylvatica_ S. Vidal	
	Kleinhovia hospita L. var. _hospita_	
	Pterocymbium tinctorium (Blco.) Merr.	
	*_Pterospermum celebicum_ Miq.	
	Pterospermum diversifolium Blume	
	Pterospermum obliquum Blanco	
	Sterculia montana Merr.	
	Sterculia oblongata R. Br.	

Symplocaceae	**Symplocos cochichinensis* S. Moore	EC
Taccaceae	*Tacca palmatum* Blume	
Theaceae	*Camelia lanceolata* Seem.	
	**Camelia sinensis* (L.) Kuntze	
Thymeleaceae	*Phaleria perrottetiana* Fern.-Vill.	
	Wikstroemia lanceolata Merr.	EC
Thymeleaceae	*Dendrocnide meyeniana* (Walp.) Chew	EC
Urticaceae	*Elatostema banahaense* C.B. Rob.	
	Elatostema dericatulum Wedd.	EC
	Laportea interrupta (L.) Chew	EC
	Leucosyke capitellata Wedd.	
	Pipturus arborescens C.B. Rob.	
Verbenaceae	*Stachytarpheta jamaicensis* (L.) J. Vahl.	
	Lantana camara L.	
Vitaceae	*Cayratia geniculata* (Blume) Gaegnep.	
	Cissus repens Lam.	
	Tetrastigma harmandii Planch.	
	Tetrastigma loheri Gaegnep.	EC
Zingiberaceae	*Alpinia brevilabris* C. Presl.	
	Alpinia elegans K. Schum.	
	Amomum trilobum Ridl.	
	Curcuma zedoaria (Be.) Rosc rg.	EC
	Globba campsophylla K. Schum.	
	Globba marantina L.	EC
	Kolowratia elegans Presl	
Unknown	Undetermined (8 spp.)	EC

Legend:
EC – endemic, T – threatened, VU – vulnerable, CR – critically endangered, N – Endangered, NT – Near threatened
* Species with <1 IVI (mportance Value Index)

sampling plots in Maragondon and Ternate were strongly correlated with elevation while sampling plots in non-PA were strongly correlated with soil and air temperature. Canonical axis 1 (eigenvalue = 0.374) is associated with RH (positive end) while Canonical axis 2 (eigenvalue = 0.263) is associated with elevation. Majority of the plots centroid were near the center of axis 1 and axis 2 indicating that the vegetation cover is still intact with thick canopy and in good condition. The eigenvalues for axis 1 is 37% and is 26% in axis 2 which accounted to 63% of the occurrence or phenomenon in relation to the different environmental factors and species distribution. These were the plots inside PA with lowland tropical evergreen dipterocarp forest type. In gradient 2, however, soil and air temperature were high indicating that the plots were disturbed and the canopy is open since there was more sunlight penetration. This means that tree species in this axis are sensitive to disturbance. The vegetation is open canopy and considered as disturbed forests where soil and air temperature are strongly correlated to the species distribution.

Floristic Composition. A total of 178 woody species with DBH≥ 10 cm representing 152 genera and 658 families were identified out of 1005 tree individuals. The top ten species with highest Importance Value Index (IVI) are as follows: *Shorea guiso* Blume (Dipterocarpaceae, 9.238), *Ficus chrysolepis* Miq. (Moraceae, 7.194), *Diospyros pyrrhocarpa* Miq. (Ebenaceae, 6.406), *Buchanania arborescens* (Blume) Blume (Anacardiaceae, 5.811), *Strombosia philippinensis* S. Vidal (Olacaceae, 5.633), *Alstonia macrophylla* Wall (Apocynaceae, 5.589), *Tarrenoidea walichii* (Hook. f.) Tirverg. & Sastre (Rubiaceae, 5.437), *Diospyros philippinensis* A. DC. (Ebenaceae, 5.154), *Diospyros pilosanthera* (Ebenaceae, 5.027), and *Canarium ovatum* Engl. (Burseraceae, 4.689). These species constituted 60.16% of the total importance value while 39.84% of importance value represented the other 168 species. *Shorea guiso*, *Diospyros pyrrocharpa*, *S. philippinensis,* and *B. arborescens* are the three most abundant species. Eighty-three species (46.63%) in all sites were represented by importance value less than 1%. Among the species included were *Aglaia leptantha* Miq. (Meliaceae), *Tabernaemontana pandacaqui* Poir. (Apocynaceae), *Citrus hystrix* DC (Rutaceae*)*, *Aglaia korthalsii* Pellegr. (Meliaceae), *Wrightia pubescens* R. Br. (Apocynaceae) and *Palaquium foxworthyii* Merr. (Sapotaceae).

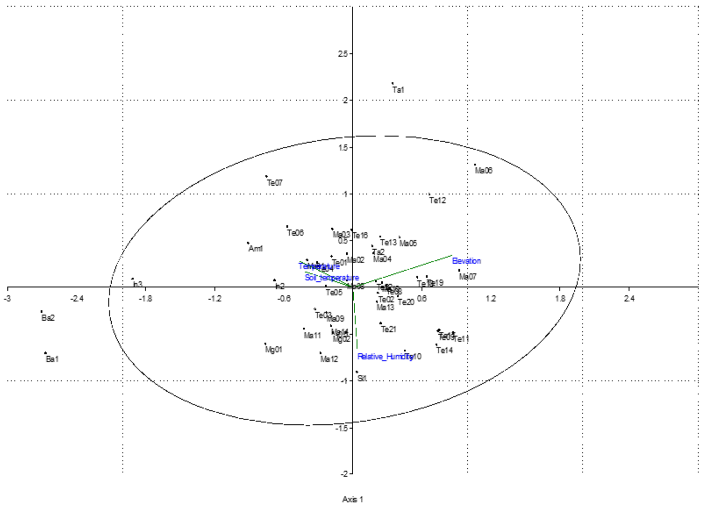

Figure 2. Canonical Correspondence Analysis (CCA) ordination biplot of sampling points on species distribution and environmental variables (elevation, soil and air temperature and relative humidity). Elevation or altitude and species distribution is strongly correlated with ordination axis 2 while relative humidity is strongly correlated with ordination axis 1. Points for tree species distribution were not shown for clearer diagram.

Luyon and Medecilo (1996) reported that 96 species occur in Mts. Palaypalay/Mataas na Gulod Protected Landscape belonging to 55 genera and 34 families where *Shorea guiso* had the highest IVI value. The sites are located in Ternate and Maragondon municipalities (Cavite) and Nasugbu (Batangas) using Point-Center-Quarter-Method composed of fourteen (14) transects measuring 100 m. The finding is similar to the present study's results; however, the number of species is higher in the present study since other fragmented forests in Upland Cavite were included. In the study of Gascon *et al*. (2013) on trees, only 92 species representing 32 families were reported in Mt. Banahaw, which is quite low compared to our study.

However, with the addition of saplings, shrubs and herbs, a total of 501 species belonging to 336 genera and 113 families were recorded (Table 2). Angiosperms have the highest number of species (501 species), followed by pteridophytes (52 species) and gymnosperms (3 species). Out of 113 families, 33 families (29.21%) were represented by one species.

The family having the most number of species is Fabaceae with 27 species, followed by Moraceae (26 species), Euphorbiaceae (25 species), Rubiaceae (24 species), and Poaceae (19 species) (Table 2). Mossy forest does not occur in Upland Cavite and this contributes to the low numbers of epiphytes and endemic species. In the study of Amoroso *et al.* (2013), high endemicity is due to epiphytic species such as orchids, pitcher plants and other montane species.

In the study of Gascon *et al*. (2013), Moraceae, Euphorbiaceae, Theaceae and Meliaceae were the most represented families. This result is comparable to our present findings. However, Theaceae in Upland Cavite was represented by only two species (Table 2). Mt. Makiling has high floral diversity (Fernando *et al.*, 2004), and it can be depicted that it has more or less similar composition to Upland Cavite because of its proximity and geographical location.

Vegetation Structure. Based on species composition and physiognomy of vegetation at each sampling station, four (4) vegetation structures were identified, namely: secondary forest, agricultural ecosystem, semi-secondary and lowland evergreen dipterocarp forest. Figure 3 shows the cluster analysis using Spearman Rho Correlation in relation to species composition. The sample plots were arranged according to similarities. The common ancestor was Maragondon and it was subdivided into two major clusters namely the plots inside PA and plots outside PA. The clusters outside PA are characterized as agro-ecosystem forest (Figure 4A) (Bailen-Tagaytay), secondary forest or disturbed (Figure 4B) (Indang), semi-secondary or mixed forest (Figure 4C) (Silang-Magallanes) and lowland evergreen dipterocarp forest (Figure 4D) (Ternate-Maragondon).

The vegetation structure of Bailen and Tagaytay is characterized as agricultural ecosystem since it is dominated by *Chrysophyllum cainito* L. (Sapotaceae), *Coffea* spp. (Rubiaceae) and *Mangifera indica* L. (Anacardiaceae). Secondary forest occurs in Indang and is dominated by *Ficus septica* Burm. f. (Moraceae), *Artocarpus blancoi* L. (Moraceae), *Macaranga grandifolia* Merr. (Euphorbiaceae), *Voacanga globosa* Merr. (Apocynaceae), *Kleinhovia hospital* L. var. *hospita* (Sterculiaceae), and *Ficus minahassae* (Teijsm. & de Vriese) Miq. (Moraceae) while Silang and Magallanes are considered semi-secondary forest or mixed forest dominated by *Ficus balete* Merr. (Moraceae), *Dracontomelon dao* (Blanco) Merr. & Rolfe, *D. edule* Merr. (Anacardiaceae), *Vitex parviflora* Juss. (Lamiaceae), *Alstonia scholaris* (L.) R. Br. (Apocynaceae) and *Sandoricum koetjape* Merr. (Meliaceae). However, Ternate and Maragondon was depicted as lowland evergreen dipterocarp forest dominated by *Shorea guiso* (Figure 3).

Assessment of conservation status of plant species. The assessment of the status of the different plant species was carried out to establish a foundation for their protection and conservation. There were at least 145 Philippine endemic species or 31% of the total number of species that were found in Upland Cavite. Among these species, *Impatiens caviteana* (Figure 6A) and *Oldenlandia stenophylla* Merr. (Rubiaceae) are endemic in Cavite alone. These two species grow near streams or wet areas and abundant during the rainy season (June to September). Some of the individuals bear flowers and fruits and reproduce easily. However, in the summer, these species dry up and eventually die.

Of the 145 endemic species, nine are vulnerable, two are critically endangered, five are threatened and one is endangered. These threatened species are: *Calamus ornatus* var. *philippinensis* Becc. (Arecaceae), *Myristica philippinensis* Lam. (Myristicaceae), *Shorea polysperma* Merr. (Dipterocarpaceae), *Syzygium densinervium* (Merr.) Merr. (Myrtaceae) and *Zizyphus talanai* Merr. (Rhamnaceae). Jade vine or *Strongylodon macrobotrys* A.

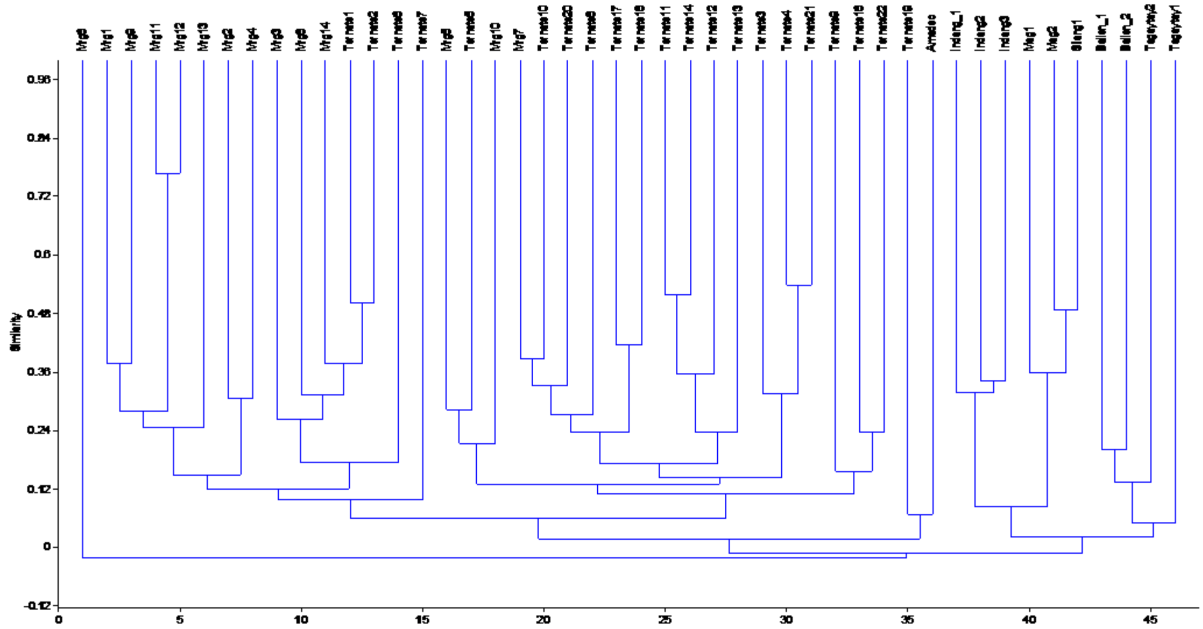

Figure 3. Cluster analysis based on species composition depicting the different vegetation sites namely agricultural (Bailen-Tagaytay), secondary (Indang), semi-secondary (Silang-Magallanes) and lowland evergreen dipterocarp forest (Ternate-Maragondon).

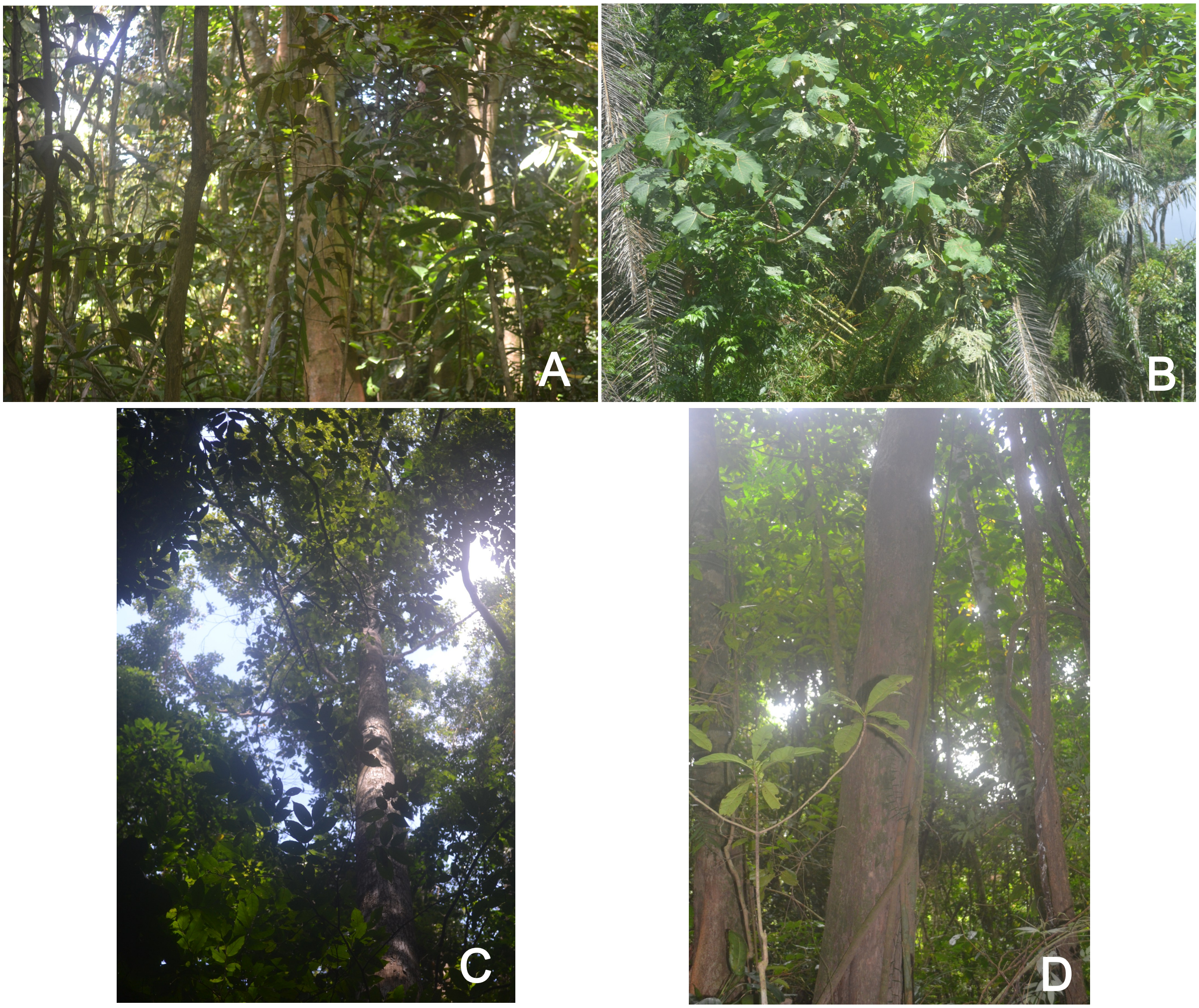

Figure 4. Different forest types in the remaining forests of Upland Cavite, Philippines. A. Agri-ecosystem forest in Bailen, Cavite showing *Chrysophyllum cainito* and *Coffea* spp.; B. Secondary forest dominated by *Macaranga grandifolia* and *Arenga pinnata* in Indang and Tagaytay; C. Semi-secondary or mixed forest in Magallanes and Silang; and D. Lowland tropical evergreen dipterocarp forest dominated by *Shorea guiso*.

Gray (Fabaceae) (Figure 6D) is abundant in lower altitude areas, while *Selaginella tamariscina* (Beauv.) Spring (Selaginellaceae) (Figure 6C) is found only in Mt. Pico de Loro. *Dillenia philippinensis* Rolfe (Dilleniaceae) (Figure 6E) occurs only in the protected area and is economically important to the community because of its edible fruit. This species is also endemic with scattered distribution in the park. Several individuals of the endemic dipterocarp species are also abundant and in need of dire protection and conservation from illegal loggers because their occurrence is in places of lower altitude and can be cut or extracted easily by loggers.

Aside from endemic species there are also plants that are economically important to the community particularly those species that can be used as food, medicine, timber, handicrafts, building material and ornament. These include *Artocarpus heterophylla* Lam. (Moraceae), *Garcinia binucao* Choisy (Clusiaceae), *Antidesma* spp., *Canarium* spp., *Syzygium* spp., *Citrus hystrix, Cinnamomum mercadoi* S. Vidal (Lauraceae), *Diplazium esculentum (Retz.)* Sw. (Athyriaceae), *Lygodium* spp. (Lygodiaceae)*,* etc.

Sixty five percent of all plant species is considered as native while 35% is introduced. Though there are species which are introduced in the country, they occur in wild habitat that in the long period of time become naturalized and can be considered as native.

The lowland evergreen dipterocarp forest contained the highest number of endemic species as well as highest

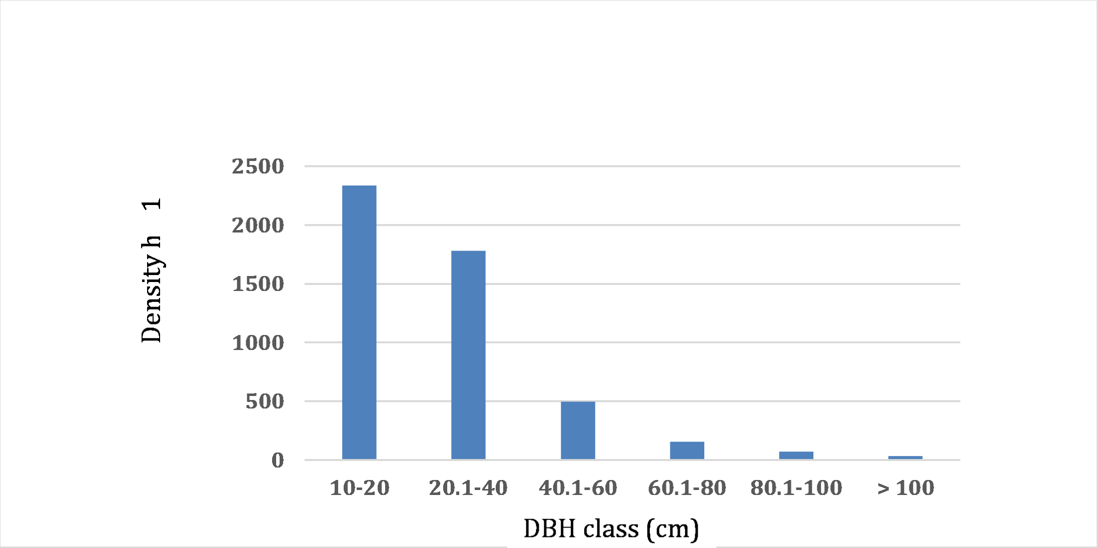

Figure 5. Vegetation structure of the remaining forests in Upland Cavite, Philippines.

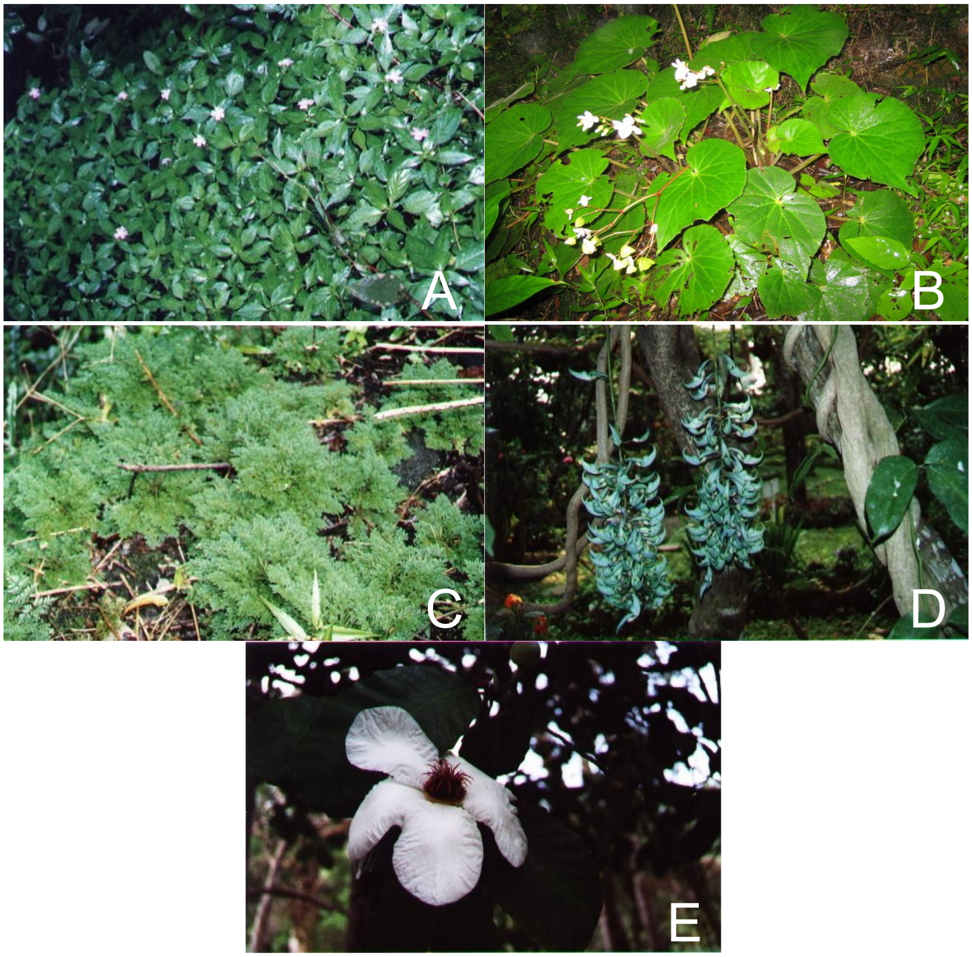

Figure 6. Some endemic angiosperm species in the remaining forests of Upland Cavite. A. *Impatiens caviteana* Merr. (Balsaminaceae); B. *Begonia calcicola* Merr. (Begoniaceae); C. *Selaginella tamariscina* (Selaginellaceae); D. *Strongylodon macrobotrys* (Fabaceae); and E. *Dillenia philippinensis* Rolfe (Dilleniaceae).

species richness. This vegetation type occur in Mts. Palaypalay – Mataas na Gulod Protected Landscape located in the towns of Ternate and Maragondon (Cavite) and Nasugbu (Batangas). The sampling site close to PA is Magallanes, however, the vegetation was considered as a semi-secondary forest. The sites are distantly located from the community, but protection and conservation were not practiced. Some of the remaining forests in non-PA sites are privately owned (i.e. Kabangaan in Silang, Indang) and were safely guarded by the owners from possible encroachment and extraction of forest products.

Threats. The floral diversity of Upland Cavite reveals that there were 475 species belonging to 329 genera and 112 families that is considered high. With the remarkable data mentioned above, Upland Cavite has an ecological significance to the people and in the vicinities located in the entire province of Cavite. The protected landscape was considered as the last haven in Cavite, which should be conserved and protected to be beneficial to the populace.

The upland farming of the residents, infrastructure development, illegal encroachment and tourism endanger the biologically diverse ecosystem of Cavite due to illegal cutting of trees. Although some forests are privately owned, (Tagaytay and Bailen) extraction of forest products was observed. The large portion of the study sites was declared as protected area, but several threats were still observed. Other threats include agricultural expansion, charcoal making, ecotourism such as resorts and mountain hiking, infrastructure such as highway development, and settlers' encroachment. Signs of "Private Property, No Trespassing" can be observed as one passes along the road from the entrance of Puerto Azul to the Philippine Marines Station. As a protected landscape, illegal encroachment is not allowed. Though tourism augments the income of the park, it also brings major damage to the area. Most of the visitors are unaware of the policies and regulations in using the facilities in the park. Garbage and other wastes are just thrown everywhere without knowing that it can also affect the cycle in the ecosystem. The influx of forest dwellers due to rapid increase in population in urban landscapes led to the destruction of natural forests, and as people try to find ways in order to survive, they continuously destroy the forests protected resources.

CONSLUSION AND RECOMMENDATIONS

Upland Cavite is a haven for diverse plants and animals because of its geographic location. It consists of 475 species representing 329 genera and 122 families. Among these species *Shorea guiso*, *Ficus chrysolepis* and *Diospyros pyrrhocarpa* were the densest and the most dominant and frequent species with the highest IVI in the protected area. The vegetation structure is categorized into four namely: secondary forest, agro-ecosystem, mixed secondary and agroecosystem and lowland evergreen dipterocarp forest. The number of endemic species is high (31%) with many vulnerable and threatened species. It is recommended that the government, private organizations (POs), the Protected Area Management Board (PAMB) and other stakeholders must give conservation and management priority to species with less than 1% IVI and families represented by only one species.

Based on the estimates of carbon stock, the mentioned top ten species with highest sequestered carbon and recommended be used as trees for reforestation and afforestation programs. Generally, the plots where the aforementioned tree species were sampled are located within the Mts. Palay-palay/Mataas-na-Gulod, Ternate/ Maragondon, Cavite, Nasugbu, Batangas Protected Landscape. Thus, conservation of this Protected Landscape should be given priority to maintain important forest ecosystem functions and services such as carbon storage and tree productivity.

ACKNOWLEDGEMENTS

The authors are very grateful to the University Research Office of De La Salle University - Dasmariñas) for the research grant. The research assistants namely: Jennifer Rose Castillo, Adrian Supetran, Vanessa Manibpel, Jazmine Nicole Pabilonia, Jonathan Alcid and Ma. Isabel Berces are also acknowledged. Special thanks are due to Tatay Edelberto Peredo and Kuya Ricky Morales who served as guides during the field visits. Mr. Danilo Tandang of Philippine National Herbarium is gratefully acknowledged for his contribution particularly in the identification of the plant species. We are also grateful to the Honorable Mayors of Upland Cavite municipalities and city and to PAMB and DENR (Region 4A) for allowing us to conduct field visits in the area. We thank the two anonymous reviewers, whose valuable comments and suggestions greatly helped us to improve the paper.

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